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Fisicoquimica de Coloides 318147424

Primera serie

Castellan (2da Edicion)

18.7)

Datos:

$r = ?$ $\rho_{savia} = 1\,g/cm^3$ $\theta = 0$ $\gamma = 73\times10^{-3}\,N/m$

Se desprecia la presion del aire

$$r = \frac{2\cos\theta\,\gamma}{\rho h g} \longrightarrow \frac{2\cos 0°\; 73\times10^{-3}}{1\,(30)(9.81)} = 4.9609\times10^{-4}\,m$$

18.9)

Datos:

$r = 0.05\,cm$ $\gamma = 0.072\,N/m$ $\Delta P = ?$

$\hookrightarrow 0.0005\,m$

Despreciar la profundidad de inmersion

$$\Delta P = \frac{2\gamma}{r} \to \frac{2(0.072)}{0.0005} = 288\,pa$$

18.13)

Datos:

$T = 20°C$ $\gamma_{benceno} = 28.85\,mN/m$ $\gamma_{agua} = 72.75\,mN/m$

$\theta = 0°$ $\gamma_{int} = 35\,mN/m$

Determinar

a) Trabajo de ahesion entre el agua y el benceno

b) Trabajo de cohesion para el benceno y para el agua

c) Coeficiente de cohesion para el benceno y el agua

a) $W_{ad} = \gamma_{agua} + \gamma_{benceno} + \gamma_{int} \rightarrow 72.75\times10^{-3} + 28.25\times10^{-3} + 35\times10^{-3}$

$= 0.1366\ N/m$

b) $W_{coh} = 2\gamma$

$A_{gua} = 2(72.75\times10^{-3}) = 0.1455\ N/m$ Benceno $= 2(28.85\times10^{-3}) =$ $0.05775\ N/m$

c)

18.19)

Acido estearico $(C_{17}H_{35}COOH)$ $\rho = 0.85\ gr/cm^3$ $A = 0.205\ nm^2$

$\hookrightarrow 284\ gr/mol$

$L = ?$

$$\bar{v} = \frac{M}{\rho} = \frac{284\ g/mol}{0.85\ g/cm^3} = 334.11\ cm^3/mol\left(\frac{1\ m^3}{10^6\ cm^3}\right) = 3.3411\times10^{-4}\ m^3$$

$$\bar{v}_{molecula} = \frac{\bar{v}}{N_a} = \frac{3.3411\times10^{-4}\ m^3/mol}{6.022\times10^{23}\ moleculas/mol} = 5.548\times10^{-28}\ m^3$$

$\hookrightarrow \left(\frac{10^{27}\ nm^3}{1\ m^3}\right) = 0.5548\ nm^3$

$\bar{v}_{molecula} = A \cdot L$

$$L = \frac{\bar{v}_{molecula}}{A_{molecula}} = \frac{0.5548\ nm^3}{0.205\ nm^2} = 2.7\ nm$$

18.25)

a) Acido acetico en agua a 30°C PM = 60 g/mol

% peso de acido	2.475	5.001	10.01	30.09	49.96	69.91
γ (10^{-3} N/m)	64.4	60.1	54.6	43.6	38.4	34.3

Graficar γ en funcion de ln m y determinar el exceso superficial del acido acetico usando la isoterma de adsorcion de Gibbs

b) Acido propionico en agua a 25°C PM = 74 g/mol

% Peso de acido	1.91	5.24	9.8	21.7
γ (10^{-3} N/m)	60	49	44	36

a) $\frac{2.475 g}{60 g/mol} = 4.125 \times 10^{-3}$ mol $\quad \frac{5.001 g}{60 g/mol} = 0.08335$ mol

$\frac{10.01 g}{60 g/mol} = 0.167$ mol $\quad \frac{30.09 g}{60 g/mol} = 0.5015$ mol

$\frac{49.96 g}{60 g/mol} = 0.832$ mol $\quad \frac{69.91 g}{60 g/mol} = 1.165$ mol

$4.125 \times 10^{-3} - \frac{97.525 g}{1000 g} = 0.0423 \quad 0.08335 - \frac{94.999 g}{1000 g} = 0.877$

$0.167 - \frac{89.99 g}{1000 g} = 1.855 \quad 0.5015 - \frac{69.91 g}{1000 g} = 7.173$

$0.832 - \frac{50.04 g}{1000 g} = 16.626 \quad 1.165 - \frac{30.09 g}{1000 g} = 38.717$

$m(C_2)$	$\ln$ (x)	$\gamma\ (10^{-3}\ N\ m)$ (y)
0.0422	-3.165	64.4
0.877	-0.131	60.1
1.855	0.61	54.6
7.173	1.97	43.6
16.626	2.81	38.4
38.717	3.626	34.3

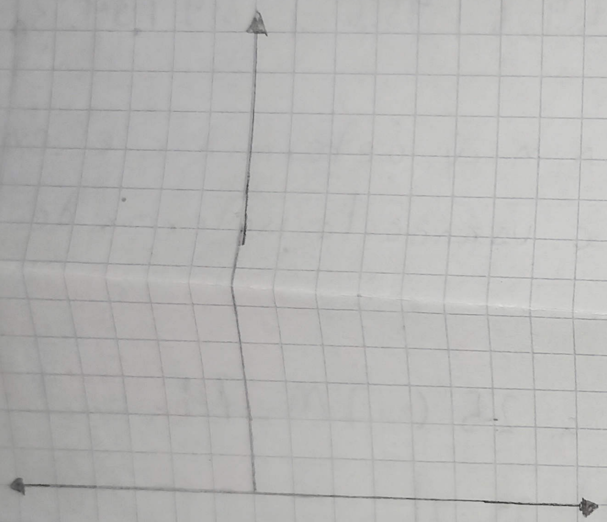
$A = 53.759$

$B = -4.747 \times 10^{-3}\ N/m$

$r = -0.9412$

$$\Gamma_2 = \frac{-(-4.747\times10^{-3})}{(8.314)(303.15)}$$

$$= 1.883\ \mu mol/m^2$$



b)

$$\frac{1.91\,g}{74\,g/mol} = 0.0258\,mol \qquad \frac{5.84\,g}{74\,g/mol} = 0.0789\,mol$$

$$\frac{9.8\,g}{74\,g/mol} = 0.1324\,mol \qquad \frac{21.7\,g}{74\,g/mol} = 0.2932\,mol$$

$$0.0258 - \frac{98.09\,g}{1000\,g} = 0.263 \qquad 0.0789 - \frac{94.16\,g}{1000\,g} = 0.8379$$

$$0.1324 - \frac{90.2\,g}{1000\,g} = 1.4678 \qquad 0.2932 - \frac{78.3\,g}{1000\,g} = 3.7445$$

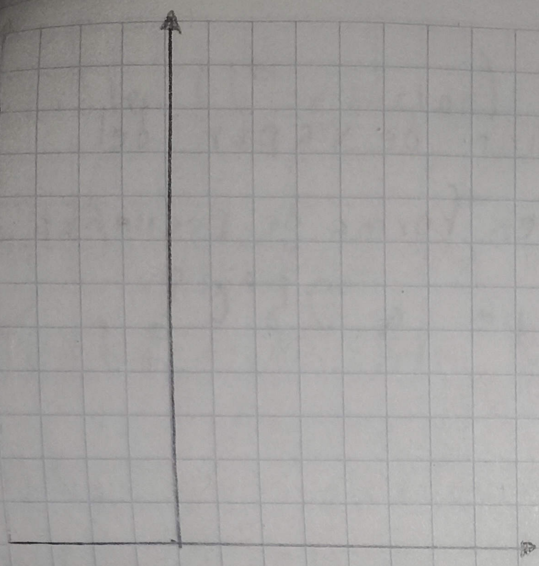
$m(C_2)$	$\ln$ (x)	$\gamma(10^{-3}\ N/m)$ (y)
0.263	-1.3356	60
0.8379	-0.1766	49
1.4678	0.3837	44
3.7445	1.3202	36

$A = 47.6858$

$B = -9.0475$

$r = -0.9996$

$$\Gamma_2 = \frac{-(-9.0475\times10^{-3})}{(8.3145)(298.15)} = 3.6497\ \mu mol/m^2$$



Atkins (3^{ra} edicion)

A7.9)

$T = 20°C \quad M = 154\, g/mol$

$\gamma_{CCl_4} = 0.027\ Nm^{-1}$

$\rho = 1.6\, g/cm^3$

$P^{\circ} = 87.05\ Torr \quad P = 87.95\ torr$

$r = \dfrac{2\gamma\bar{V}}{RT\ln\left(\frac{P}{P_0}\right)} \qquad \bar{V} = \dfrac{M}{\rho} = \dfrac{154\, g/mol}{1.6\, g/cm^3} = 96.25\, cm^3 \times \dfrac{1\, m^3}{10^6\, cm^3} = 9.625\times10^{-5}\, m^3$

$r = \dfrac{2(0.027\, Nm^{-1})(9.625\times10^{-5}\, m^3)}{(8.314\, \frac{Nm}{mol\, K})(293.15K)\ln\left(\frac{87.95\, torr}{87.05\, torr}\right)} = 2.07\times10^{-7}\, m$

A7.10)

$P_{int} = ? \quad P_{ext} = 740\, torr \quad r = 0.125\, mm \quad \gamma = 5.7\times10^{-2}\ N/m$

$\hookrightarrow 0.000125\, m$

Calcular presion interna de la burbuja

$\Delta P = \dfrac{2\gamma}{r} \rightarrow P_{int} - P_{ext} = \dfrac{2\gamma}{r} \rightarrow P_{int} = \dfrac{2\gamma}{r} + P_{ext}$

$P_{int} = \left(\dfrac{2(5.7\times10^{-2}\, N/m)}{1.25\times10^{-4}\, m}\right) + 740\, Torr = 1652\, Torr$

7.39) En cuanto cambia la presion de vapor del benceno cuando este se dispersa en forma de pequeñas gotas de radio a) 10 µm, b) 0.10 µm a 25°C ?

7.41)

Agua $\quad h = \frac{2\gamma}{\rho r g}$

$\gamma = 7.28 \times 10^{-2}\ N/m$ (a 20°C) $\quad \gamma = 5.8 \times 10^{-2}\ N/m$ (a 100°C)

$\rho = 0.998\ g/cm^3 \rightarrow 998\ kg/m^3 \quad \rho = 0.958\ g/cm^3 \rightarrow 958\ kg/m^3$

Calcular elevacion en tubos de a) 1 mm b) 0.1 mm de radio

$\hookrightarrow 0.001\ m \quad \hookrightarrow 0.0001\ m$

$$\frac{2(5.8 \times 10^{-2}\ \frac{kg\ \cancel{m}}{\cancel{s^2}})}{998\ \frac{kg}{\cancel{m^3}}(0.001\ \cancel{m})(9.81\ \frac{\cancel{m}}{\cancel{s^2}})} = 0.0118\ m$$

$$\frac{2(5.8 \times 10^{-2}\ \frac{kg\ m}{s^2})}{998\ \frac{kg}{m^3}(0.0001 m)(9.81\ \frac{m}{s^2})} = 0.1184\ m$$

$$\frac{2(5.8 \times 10^{-2}\ \frac{kg\ m}{s^2})}{958\ \frac{kg}{m^3}(0.001 m)(9.81\ \frac{m}{s^2})} = 0.0123\ m$$

$$\frac{2(5.8 \times 10^{-2}\ \frac{kg \cdot m}{s^2})}{958\ \frac{kg}{m^3}(0.0001 m)(9.81\ \frac{m}{s^2})} = 0.1234\ m$$

20°C

25°C

Laidler (1^{ra} edición)

18.17)

$\gamma = 7.27 \times 10^{-2}$ N/m $\rho = 0.998$ g/cm^3 $\theta = 0°$ $g = 9.81$ m/s
↳ 998 kg/m^3

a) Calcular elevación del agua en capilares de 1 mm de radio
b) Calcular elevación del agua en capilares de 10^{-3} cm radio

Para a):

$$h = \frac{2\gamma \cos\theta}{\rho g r} = \frac{2(7.27\times10^{-2})\cos 0°}{(998)(9.81)(0.001)} = 0.1485 \text{ m}$$

↳ 1.485×10^{-1} m
↳ 14.85 cm

Para b):

$$\frac{2(7.27\times10^{-2})\cos 0°}{998(9.81)(1\times10^{-5})} = 1.4851 \text{ m}$$

18.21)

$h_1 = 1.5$ cm $\theta = 0°$ $\gamma_2 = \frac{1}{2}\gamma_1$ $\rho_2 = \frac{1}{2}\rho_1$ $g = 9.81$ m/s
$h_2 = ?$

18.25)

$A = \frac{1}{2}$ acre $\rightarrow$ 1 acre = 4840 yd^2 $\rightarrow$ 1 yarda = 0.915 m

$V = 1\ cm^3$ espesor = ?

$4840(0.915)^2 = 4052\ m^2$; $\frac{1}{2}$ acre = 2026 m^2

$\frac{1 \times 10^{-6}\ m^3}{2026\ m^2} = 4.9358 \times 10^{-10}\ m$ $1\ cm^3 = 1 \times 10^{-6}\ m^3$

18.26)

$T = 15°C$

$A = cm^2\ \mu g^{-1}$	5.7	28.2	607	1070	2200	11,000
$\gamma = 10^{-3}$ N/m	30	0.3	0.2	0.1	0.05	0.01

Estimar el peso molecular y el area por molecula cuando la pelicula esta totalmente comprimida

$1.11 \times 10^{4}\ N\ m/kg = (J/kg)$

$8.3145(288.15) = 2,395.823\ J/mol$

$PM = \frac{2,395.823\ J/mol}{1.11 \times 10^{4}\ J/kg} = 0.2158\ kg/mol \rightarrow 215.8\ g/mol$

$1\ \mu g = \frac{6.022 \times 10^{23}(10^{-6})}{216} = 2.7879 \times 10^{15}$ moleculas

$$A_{molecula} = \frac{5.7\,cm^2}{2.7879 \times 10^{15}} = 2.0445 \times 10^{-15}\ cm^2/molecula$$

$$= 0.2044\ nm^2/molecula$$

18.18) $\ln \frac{P}{P_0} = \frac{2\gamma \bar{v}}{r R T}$

P = Presion de vapor de las gotitas

P_0 = Presion de vapor en sup. plana

r = radio de las gotas

$m = 10^{-12}\ g$

$\gamma = 7.27 \times 10^{-2}\ Nm^{-1}$

$\rho = 0.998\ g/cm^3$

$M = 18\ g/mol$

$T = 20°C$

$\rho = \frac{m}{V_{gota}}$

$V_{gota} = \frac{m}{\rho} = \frac{10^{-12}\ g}{0.998\ g/cm^3} = 1.002 \times 10^{-12}\ cm^3$

$V_{gota} = \frac{4}{3}\pi r^3$

$r = \sqrt[3]{\frac{3 V_{gota}}{4\pi}} \rightarrow \sqrt[3]{\frac{3(1.002 \times 10^{-12})\ cm^3}{4\pi}}$

$r = 6.208 \times 10^{-5}\ cm \left(\frac{1\ m}{100\ cm}\right) = 6.208 \times 10^{-7}\ m$

$\rho = \frac{M}{V} \rightarrow \bar{v} = \frac{M}{\rho} = \frac{18\ g/mol}{0.998\ g/cm^3}$

$\rightarrow 18.04\ \frac{cm^3}{mol}\left(\frac{1\ m^3}{10^6\ cm^3}\right) = 1.804 \times 10^{-5}\ m^3/mol$

$\frac{P}{P_0} = \exp\left[\frac{2\gamma \bar{v}}{r R T}\right]$

$$\frac{2\gamma \bar{v}}{rRT} = \frac{2(7.27 \times 10^{-2}\ Nm^{-1})(1.804 \times 10^{-5}\ m^3/mol)}{(6.208 \times 10^{-7}\ m)(8.314\ \frac{Nm}{mol\,K})(293.15\ K)}$$

$\rightarrow 1.7345 \times 10^{-3}$

$\frac{P}{P_0} = e^{1.7345 \times 10^{-3}}$

$\frac{P}{P_0} = 1.001$